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ABSTRACT

Based on the author's presentation at the International Conference on Computer Based Learning in Science, this paper discuses some high profile areas of interest and concern in the educational use of information and communication technology (ICT). The paper is influenced partly by a series of nine government funded "Best Practices" projects in the use of ICT and partly by experience. In particular, the paper addresses four major areas: (1) establishing an electronic identity, including alternative delivery/online learning issues (e.g., curricula, quality of learning, staffing, administration, equality, and cost) and World Wide Web site development; (2) technological literacy of students, including the Information and Communication Technology Program Studies initiative by the Province of Alberta (Canada); (3) support for the use of ICT with an emphasis on security in a distributed network environment (e.g., physical security, viruses, and network access); and (4) access to information and protection of privacy. (Author/MES)

A Best Practices Approach to the Use of Information Technology in Education

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Abstract: Based on a presentation at the International Conference on Computer Based Learning in Science (Wright,1999), this paper discusses some high profile areas of interest and concern in the educational use of information and communication technology (ICT). This paper is influenced partly by a series of nine, government funded "Best Practices" projects in the use of ICT and partly by experience. In particular the paper addresses four major areas, notably, establishing an electronic identity (including alternative delivery/ online learning and web site development), technological literacy of students, support for the use of ICT (with an emphasis on security in a distributed network environment) and, very briefly, access to information and privacy.

Establishing an Electronic Identity

Today, having an electronic identity is synonymous with having a web site. As the enterprise of education becomes more competitive and more responsive to its stakeholders, it is hard to imagine an educational institution that doesn't have an informational web site. If that educational institution is involved with the delivery of instruction, however, there is an increasing probability that it will have become interested or involved with a second dimension of electronic identity notably, alternative delivery (almost a pseudonym for web-based learning). Since a web site commonly underpins both the informational and alternative delivery components of electronic identity, this section includes a very brief list of things to keep in mind when planning and creating a web site

Alternative Delivery

The term alternative delivery can be used to represent almost any approach to instruction which differs significantly from traditional approaches (i.e. those that are typified by a group of learners receiving instruction by expository methods). For example, the use of Computer Assisted Instruction (CAI) in the learning mathematics or the use of Computer Assisted Interactive Videodisc technology to enhance the understanding of kinematics (see Wright & Pasek 1997) are contemporary, classroom-based examples of alternative delivery. Distance education, an evolution of learning-by-mail (or correspondence school as it was commonly called) is an important subset of alternative delivery. Over the course of time, many developments and innovations were introduced into distance education including the use of television, audio conferencing, and Fax technology. Despite these approaches, early attempts at distance education were largely unsuccessful particularly if judged by student success/completion rates. More recently, computer technology has been introduced into the distance education equation. While computers have continued to become faster and more powerful in the last decade by far the most significant developments have occurred in the communications area. In particular, these developments have given rise to the Internet and, through it, the World Wide Web (the Web). Interest in the Internet and related technologies has grown at a phenomenal rate. Much more than a communications vehicle because of the technologies that it can connect, the Internet is seen as having enormous potential in education. Not only does it promise to impact the general teaching/learning paradigm, it will almost certainly redefine alternative delivery. This is evidenced by the emergence of virtual schools and opportunities for online learning. Reasons for choosing online learning include:

- geographical barriers to attending conventional classes
- access to programs or courses that are not available locally (or on-site)
- conflict with the social or religious values of a school or school system
- preference for home schooling
- reasons relating to health or physical ability
- conflict with other responsibilities or commitments (e.g., employment)
- preferences relating to the pace of learning
- preferences relating to learning style

At first glance, these reasons might not seem to differ from those that would have applied to earlier implementations of distance education. However, the fact that most of them are now underpinned by electronic curricula, multimedia technology and the Internet (and all that it implies in the way of communication and access to information) makes the situation very different. So much so that online learning might well be chosen by resident learners.

Today, alternative delivery can embrace the latest in information and communication technology (such as multi-point interactive video conferencing and multimedia rich CBL) to deliver instruction either at a distance or locally to achieve one of its main objectives - self-directed, time and place independent learning. Approaches to alternative delivery can be many and varied. At one end of the spectrum it might simply imply the delivery of self contained, units of instruction or CAI software either by traditional or electronic means (e-mail or Internet). At the other end of the spectrum of sophistication, alternative delivery might entail the simultaneous instruction of several groups of learners using computer managed interactive video technologies. This latter interpretation opens up the prospect that, through creative scheduling, several classes of math students in more than one school might be able to receive instruction from the best math teacher in the district. Obvious parallels exist for the potential of electronic learning in postsecondary education but to an even greater degree.

Issues and Concerns

While alternative delivery is currently a very high profile area it is still in its infancy. As with most innovations before it, there has been a lot more said and demonstrated about its promise than has been operationalized. The issues/questions surrounding the use of ICT for alternative delivery (and online learning in particular) are many and varied and thus only a few are listed here.

Curricula: How will various curricula be made available in electronic form? It is important that curricula be re-engineered to take advantage of the power and potential of ICT. Who will do this and what processes will need to be put in place to maintain and update courses?

Quality of learning: Undoubtedly one of the most important questions of all. How will the quality of the leaning experience be ensured? Beyond the expectations, the anecdotal, and the short-term indicators, what evidence exists to confirm the quality and the depth of learning that has taken place? Indicators of quality include completion rates, student achievement, and parent and learner satisfaction. Research is under way to address this question.

Staffing: Teachers will need to be specially trained to support online learning. Teaching contracts will need to be redefined to reflect what will be a very different role. Teachers will need to be screened for their suitability to the role. Evidence already suggests that self-paced learning places a very heavy demand on teachers who need to respond to a diversity of student requests (Farber 1998). The term teacher burnout comes to the fore here. As well, it has been observed that communication with a group of learners is easier face-to-face than electronically. Being a virtual-school teacher is very demanding.

Administration: Today, many online learning experiences are centered on the establishment and use of a web site. Questions here include: who will develop, maintain, and update the site; what are the legal implications of electronic publishing; and who will assume responsibility/stewardship of the web site? Will other teachers know how to use/update the site or will their be a dependency on one individual? From a practical point of view, how dependent will the school become on the site both from the technical and staffing perspectives. What are the contingency plans if the site goes down?

Equality: If online learning is implemented in a school or jurisdiction, will all prospective learners have (equal) access to the learning opportunities available? Related to this concern are bandwidth, local access to computer workstations, and telecommunications costs.

Cost: Everything comes with a cost. There is the obvious initial cost of hardware and software and the less obvious cost of "evergreening" of hardware, upgrading of software, telecommunications, development and maintenance of electronic curricula, delivery systems, technical support, and staff training and development.

The proliferation of alternative delivery and online learning has different implications for regular schooling than it does for postsecondary education. In regular schooling, it would seem that the approach would be less acceptable at the lower grade levels than at the higher levels. At the postsecondary level, where learners are more likely to be independent and self motivated, the prognosis is quite different. Some observers (e.g., Noam 1995) go so far as to predict that electronic learning will not only become prevalent but will lead to universities and colleges losing their exclusivity in the delivery of postsecondary education.

Teachers' fears that the computer might either replace them or de-skill their profession (as referenced by the World Confederation of Organizations of the Teaching Profession, 1987) seem to prevail. This notion is supported by observations such as "in their bones educators know that technology will replace people. It always has and it always will. About this matter, educators' hunches and fears are justified (Doyle 1992)." Advocates of the use of ICT for alternative delivery have suggested that its use will free the teacher to do what they do best and that the role of the teacher will change from dispenser of knowledge to coach, facilitator, and mentor – well worn cliches. Only time will tell if this prediction turns out to be true in general. Early indicators are that technology *is* being used to reduce face-to-face contact between the learner and the instructor but that this has not necessarily led to increased efficiency or staff satisfaction (except perhaps for the technocentric).

With most universities and colleges being able to offer online delivery of courses and programs, competition for students (and the funding and fees that follows them) will evoke significant questions. Increasingly, one might expect to see more institutions incorporating competitors' course offerings within their programs. Accreditation of both courses and programs thus becomes an issue. This is an interesting situation given that the number of prospective students is finite.

The use of alternative delivery is likely to appeal to educational administrators who see this approach as a way of reducing the number of teachers required and thus the cost of doing business (Wright & Pasek 1995). It is probably accurate to say, however, that using technology in education has increased the cost of the endeavour. If all we do is splice technology onto existing ways of doing things, we will not be able to afford to use technology in education (Mcabe 1996). To capitalize on the promise of ICT, educational paradigms will need to change. An interesting question arises in this regard, however. Will we witness the emergence of superstar teachers/professors who, being acutely aware of the fact that they are reaching very large audiences, will seek to negotiate lucrative contracts much like their counterparts in the sports and entertainment industries? If so, between the cost of technology and staffing, the economic advantage might not be as significant as perceived. As well, could it be that much further in the future we will witness the emergence of postsecondary institutions whose claim to fame will be "a non-virtual

Planning and Creating a Web Site

It is not possible to do justice to web site design and development in the space available for this paper and yet it is too important to be completely omitted. With this in mind only the briefest of comments are made here together with a list of "things to keep in mind when planning and creating a web site". It is important to conceptualize the web site before doing anything. An educational web site is usually driven by a site index which typically separates content from processes. The content area includes two major categories notably, curricular content (e.g., course and program information) and administrative information (e.g., the institutions mission, program descriptions, calendar information etc.) Alternative delivery/online learning is a subset of curricular content. The process functions of a web is typified by such things as communication, access to general information on the institution and its operations and online registration. Questions to address/things to keep in mind when planning and creating a web site include:

The questions

- what are the goals for the site and are they realistic
- who is the audience, what is the message and does the site complement existing strategies
- will the site be hosted locally or will it be outsourced
- how will success be measured
- do institutional or other publishing guidelines exist (including copyright and security)
- who can develop and, more importantly maintain, the site (expertise and resources)
- is the administration committed to the site and its implications, should a web site team be established

Some do's and don'ts

- define who owns the site
- involve stakeholders in the development of content
- keep the site current
- start small but plan for expansion (in the meantime, don't post partially constructed pages)
- understand the demographics of your audience(s)
- don't overdo links
- test all links
- repeat design elements
- minimize the overhead associated with multimedia elements
- engender principles of equality and respect and preserve individual rights and privacy

Technological Literacy of Students

It is instructive to think of the use of ICT by a teacher as falling into one of two broad categories. Teachers can use ICT;

1) as a tool that can be applied to address any task-related problem or challenge or

2) in the practicing of their craft (teaching)

The use of ICT for alternative delivery is an example of category two. For those who are involved in teacher education it is important that both categories be advocated and role modeled. For the students in the regular schools it is the first category, the achievement of technological literacy, which is of most significance. Over time, a number of approaches to achieving this goal have been pursued.

Recently, the Province of Alberta (Canada) has undertaken a very significant leadership initiative to address the technological literacy of students at all grade levels from early childhood to grade twelve. Adopting an integrated approach, the Department of Education has defined an interim program of studies called the Information and Communication Technology Program Studies that will be implemented province wide beginning in September

2000. This program (see Learner Outcomes in Information and Communication Technology, 1997) defines learner outcomes in technology for each grade level according to three categories:

Foundational Operations, Knowledge and Concepts: Outcomes in this category include understanding the nature and impact of technology, the moral and ethical use of technology, mass media in a digitized context, ergonomic and safety issues, and basic computer telecommunication and multimedia technology operations.

Processes for productivity: Outcomes in this category focus on the knowledge and skills required to use a variety of basic productivity techniques and tools. They include text composition, data organization, media and process integration, electronic communication and navigation, collaboration through electronic means, and graphical, audio and multimedia composition and manipulation.

Inquiring, Decision-making and Problem-solving: Outcomes in this category build on the foundational operations, knowledge and concepts, as well as the ability to use a variety of processes. They include the ability to critically assess information, manage inquiry, solve problems and use research techniques. They should be addressed within the context of such subjects as language arts, mathematics, social studies and science Students should be expected to apply their knowledge and skills in practical situations.

Three very significant things about this initiative are:

1) that it has elevated learner outcomes in technology to the status of a program of studies on a par with mathematics, science, language arts, and social studies

2) that its objectives are integrated across all disciplines, and

3) that its implementation is not a matter of choice for the province's schools.

Rather than restricting itself to the teaching of skills in relative isolation, this program emphasizes ICT as a process and a natural way of thinking when addressing a problem or challenge.

Supporting the use of ICT

Up until the late nineteen-seventies, computing services were mostly centralized. Those requiring service requested that service from a data processing department that employed a team of programmers and systems analysts to operate a mainframe computer. At about this time, however, the microcomputer burst upon the scene. Users welcomed the microcomputer because it allowed them to address their own needs. Seemingly, there was less need for teams of data processing professionals. As the use standalone microcomputers increased, computing took on a decentralized nature. Although foreseeable, the limitations of the decentralized approach soon became apparent as evidenced by the development of local, incompatible systems that could not even share corporate data. In the last decade, microcomputers have become enormously powerful, more powerful than their mainframe predecessors. By far the most significant developments in the recent decade have occurred in the networking and telecommunications areas. Deceptively small computers that are networked to the rest of the world now sit on individual users' desktops. Distributed computing has truly arrived. The good news is that such an environment offers the prospect of standards, effective data resource management, and unparalleled access to information. Perhaps the not-so-good news is that, in becoming sophisticated, the computing environment has once again become complex thereby creating the need for distributed support which amounts to a small army of data processing professionals (especially network specialists). Recently, this need has been increased by presence of the insidious "millennium bug".

The foregoing speaks to the need for *technical* support for the use of ICT - but this is not the only support required. There is also a need to provide staff development and support for instructors who are not only expected employ technology in their teaching but to develop the technological literacy of their students. As well, in a technological age, there is an increased need to respect rights associated with freedom of information and protection of privacy.

Security in a Networked Environment

In a distributed, networked environment, a great deal of attention needs to be paid to security. The greater the connectivity, the greater the need for policy, procedures, and vigilance regarding security. As with most corporations, educational institutions will keep both corporate and human resource data in their computers Beyond this, however, educational institutions maintain sensitive personal data (including counseling records) on captive dependents who are under the age of majority - the students. Maintaining such records increases both risk and responsibility regarding security. Because it is accessed frequently by both staff and students, a school's network may be more at risk than a typical corporation's network. The topic of network security is vast and it would be impossible to do it justice here. As well, rapidly evolving technology poses new security challenges. For these reasons only a few issues and concerns are raised here and they are dealt with briefly.

Issues and Concerns

Physical security: The need to provide for the physical security of ICT is self-evident. The provision of physical security implies ensuring that ICT stays where it is supposed to be and that access to it is effectively regulated.

Viruses: Computer viruses come in a variety of forms and disguises. Before networks became prevalent, most viruses were introduced to computer systems via diskettes. This method of infection is still a significant concern in educational institutions where it is common for students to transfer work between home and school computers. The concern is not so much that corporate systems will be affected by such transmission but that computers that are needed for instructional purposes will. Effective antiviral software is available but it is important to upgrade this software as new viruses emerge. Networks greatly increase the risk that infections will occur since they can facilitate the introduction of viruses from remote locations (e.g., by file transfers, e-mail).

Network access: This is a very complicated area. These days, networks tend to be segmented thereby providing different levels of access. It is not uncommon for institutions to have an intranet, an extranet, and access to the Internet. An intranet is typically the most limited (and usually localized) network - it is generally very private and/or custom. Access to such a network is usually restricted to immediate "insiders". In the case of a school this includes staff and students. The cornerstone of security in this regard is generally password protection. Extranets are also somewhat private though they typically extend the reach of the network to external stakeholders who are strongly linked to the client base or corporation. In the case of a school district, the extranet would typically include all of the schools. Again a key element of security is password protection. Intranets and extranets are particularly vulnerable to hackers (people whose intent is to break into a system either to gain some advantage or to inflict damage). In part this is due to the fact that extranets use the same widely publicized protocols as the Internet and in part because the motivation for a vindictive act is more likely to originate from within. While it is not possible to guarantee protection against hackers, the best way to minimize this risk is to have the best network security possible and to be vigilant. Providing access to the Internet not only increases the need for security it adds another dimension - access to socially or legally unacceptable sites. Incorporating Internet increases the prospect of unauthorized or undesired access to and from private networks. One method of managing access to the Internet is to implement a "firewall". Firewalls can be hardware or software based or a combination of both. All messages entering or leaving an extranet are examined by the firewall, which can block those that do not meet defined security criteria. Typically, firewalls keep transaction logs that enable use of the network to be studied. These logs can be helpful in detecting and addressing misuse of the network. One disadvantage of firewalls is that, because they examine all data packets, they can "slow down" the network. Some service providers have offered the use of proxy servers through which users can circumvent some features of firewalls. The firewall would log the access to the proxy server but not access to sites reached via that server.

Access to Information and Protection of Privacy

Computer networks provide unprecedented access to information. Within this environment there needs to be an increased consciousness for protecting the privacy of individuals. The province of Alberta recently passed

legislation to govern the use of information by government funded bodies. This legislation, referred to as the Freedom of Information and Protection of Privacy (FOIPP) act, not only applies to government agencies but to public schools and all other publicly funded educational institutions. This legislation protects students as well as staff. The guiding principles behind the legislation are:

- *Right of access*: The act allows any person a right of access to records in the custody or under the control of a public body subject to limited and specific exceptions
- *Right of access to information about oneself*: The act allows individuals the right to access information about themselves that is held by a public body subject to limited and specific exceptions.
- *Protection of informational privacy*: The Act requires public bodies to control the manner in which they collect, use, and disclose records that relate to an individual and to take reasonable measures to ensure they are accurate and secure.
- *Right of correction*: The act allows individuals a right to request corrections to information about themselves that is held by a public body
- *Independent review*: The act provides that all decisions made by a public body under the legislation may be reviewed by the Office of the Information and Privacy Commissioner. This means that the Commissioner may review decisions regarding access to information and other questions relating to the implementation of the provisions of the Act.

Within the context of this paper, a public body implies a school, a school district, or a postsecondary institution. The concept of a record is very broad. A record implies information in any form including books, documents, maps, drawings, photographs, letters, vouchers, papers, or any other information that has been recorded in any way either in writing, by photographic reproduction, or electronically. It is not legal to destroy such records at will and the onus is on the custodian of the record to produce them if required to. In many ways this legislation is not introducing new requirements but rather, it is adding legal weight to the implementation of acceptable policy. The passing of this legislation is causing considerable attention to be paid to the capturing and management of records on computers. Those that maintain and manage records must; ensure that staff can identify, locate, and produce records, ensure that records are accurate and complete, and that there is a viable and authorized system for destroying or disposing of records.

Issues and Concerns

Whether legislation exists or not, security has always been of concern in information management. The combined effect of technology *and* the enactment of legislation, however, heighten this concern. A vast amount of personal and other confidential information is now being stored electronically in databases that are accessible via networks. Some information has been stored on removable and transportable media such as diskettes and videotapes. In many cases, erasing a disk implies only that the directory has been destroyed, not the information that is accessed through it. As well, e-mail has added a new dimension since such transactions constitute a record. To this end it is important to take great care about the content of e-mail messages. It may sound paradoxical but E-mail messages are not necessarily destroyed even if they are erased. What about access to sites on the Internet? Such transactions are traceable through the use of firewall and other logging procedures. Increasingly, educational institutions are using web sites to disseminate information that is made available by routine disclosure or active dissemination. Information such as school budgets, school timetables, general achievement, special events, and minutes of public meetings can conveniently be communicated in this manner. In so doing, care must be taken to ensure that those who do *not* have access to electronic communication are kept equally informed.

Care must be taken when working with students particularly if they are underage dependents. Increasingly, student work, which may include personal information, is being posted on web sites. In many cases students are encouraged to develop their own web sites. The development, and in particular the posting, of web sites by

students should be carefully supervised. All manner of transgressions can occur from conflict with community values, to violation of copyright, to invasion of privacy.

Technology is a great amplifier of human endeavour, it is also a great amplifier of mistakes and transgressions. Even in the face of rapidly evolving technology, the best strategy for dealing with information management is to develop and clearly communicate a well-conceived policy of governance.

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